No. 865,296. PATENTED SEPT. 3, 1907.

R. CONRADER.

MEANS FOR ACTUATING FLUIDS.

APPLICATION FILED FEB. 24, 1903. RENEWED JAN. 14, 1907.

4 SHEETS—SHEET 1.

Fig. 1.

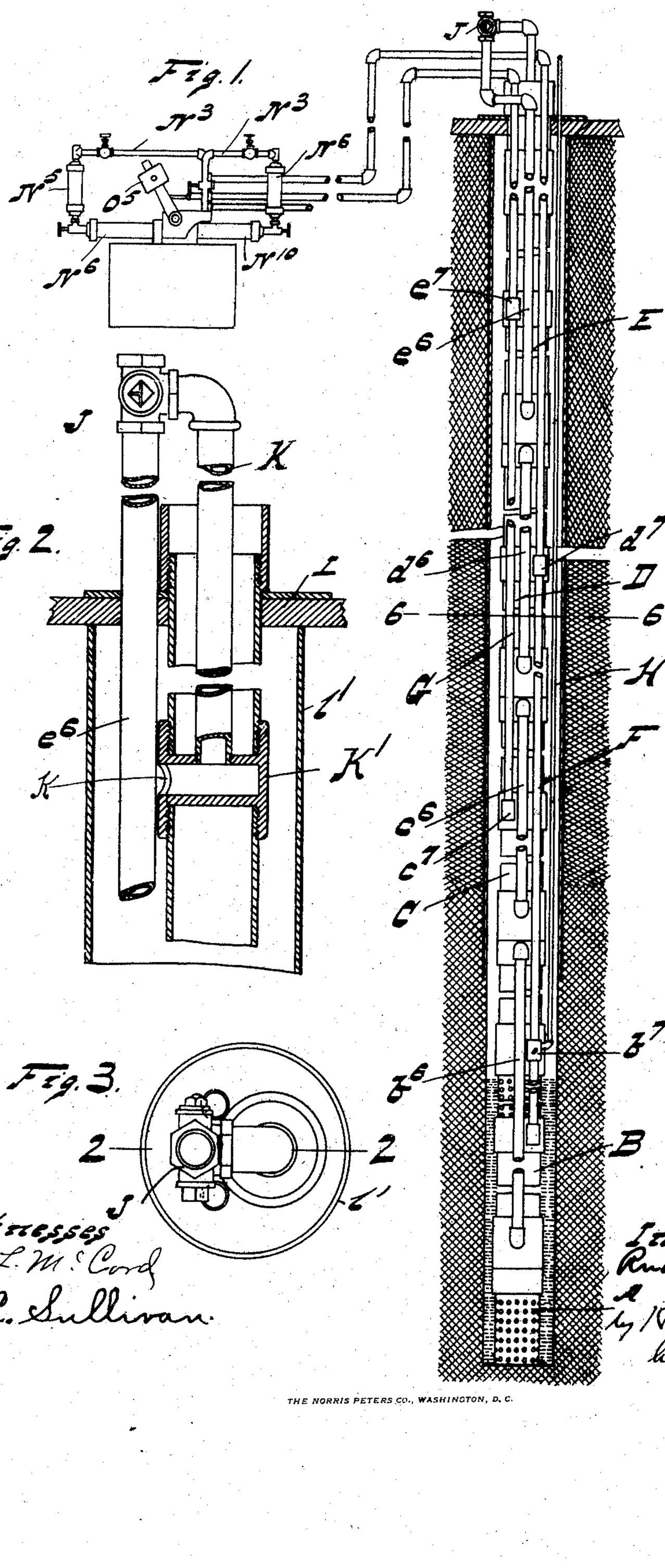

Fig. 2.

Fig. 3.

Witnesses
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4 SHEETS—SHEET 2.

Fig. 4.

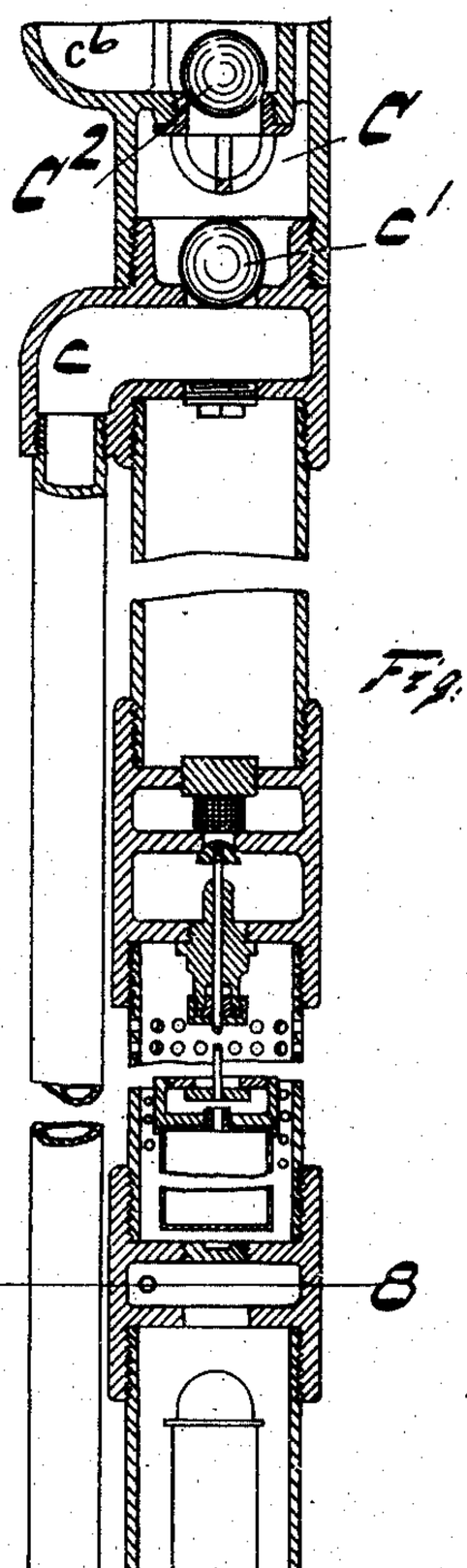


Fig. 5.

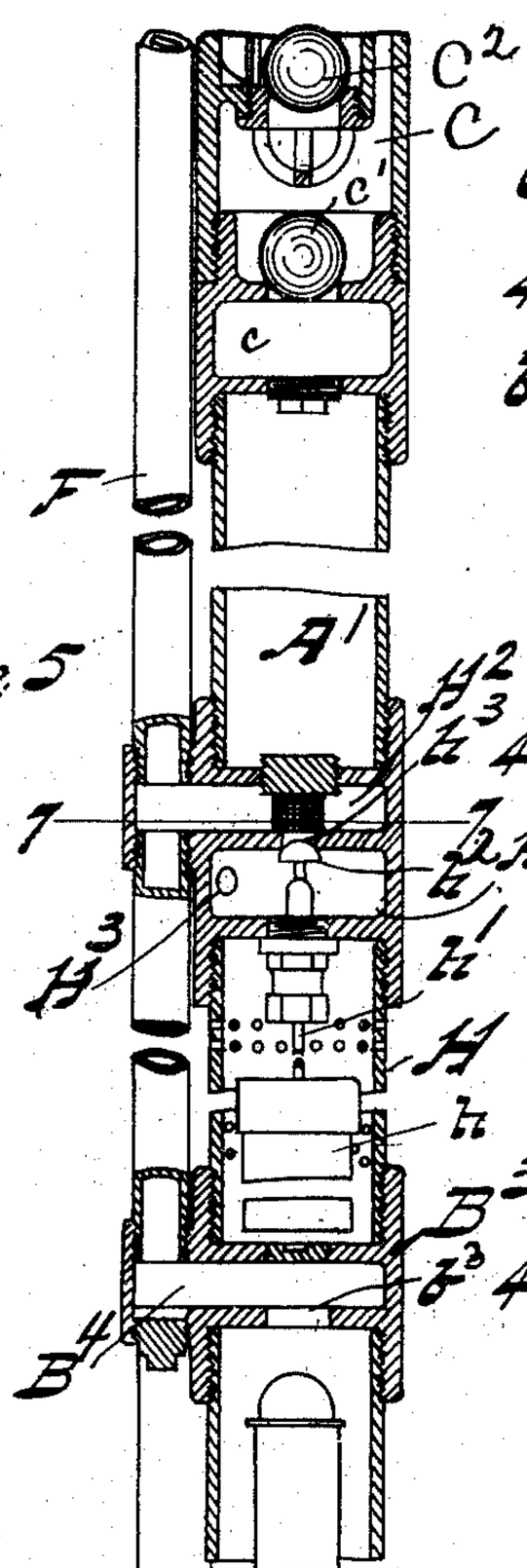


Fig. 6

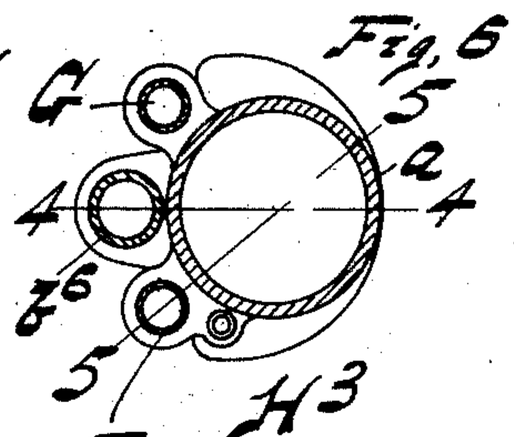


Fig. 7

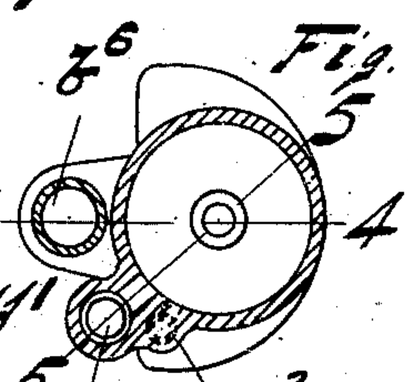


Fig. 8.

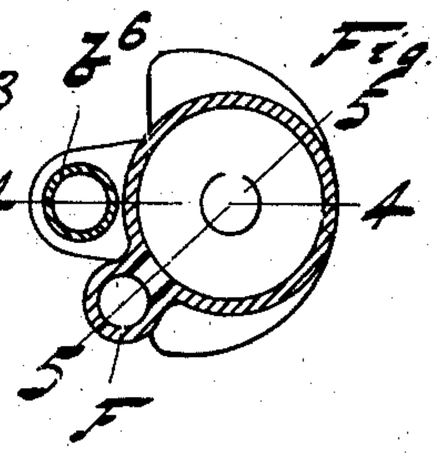
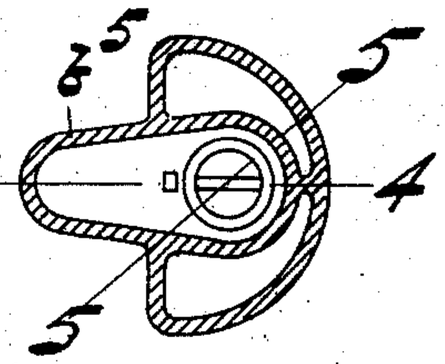


Fig. 9.



Witnesses
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4 SHEETS—SHEET 3.

Fig. 10.

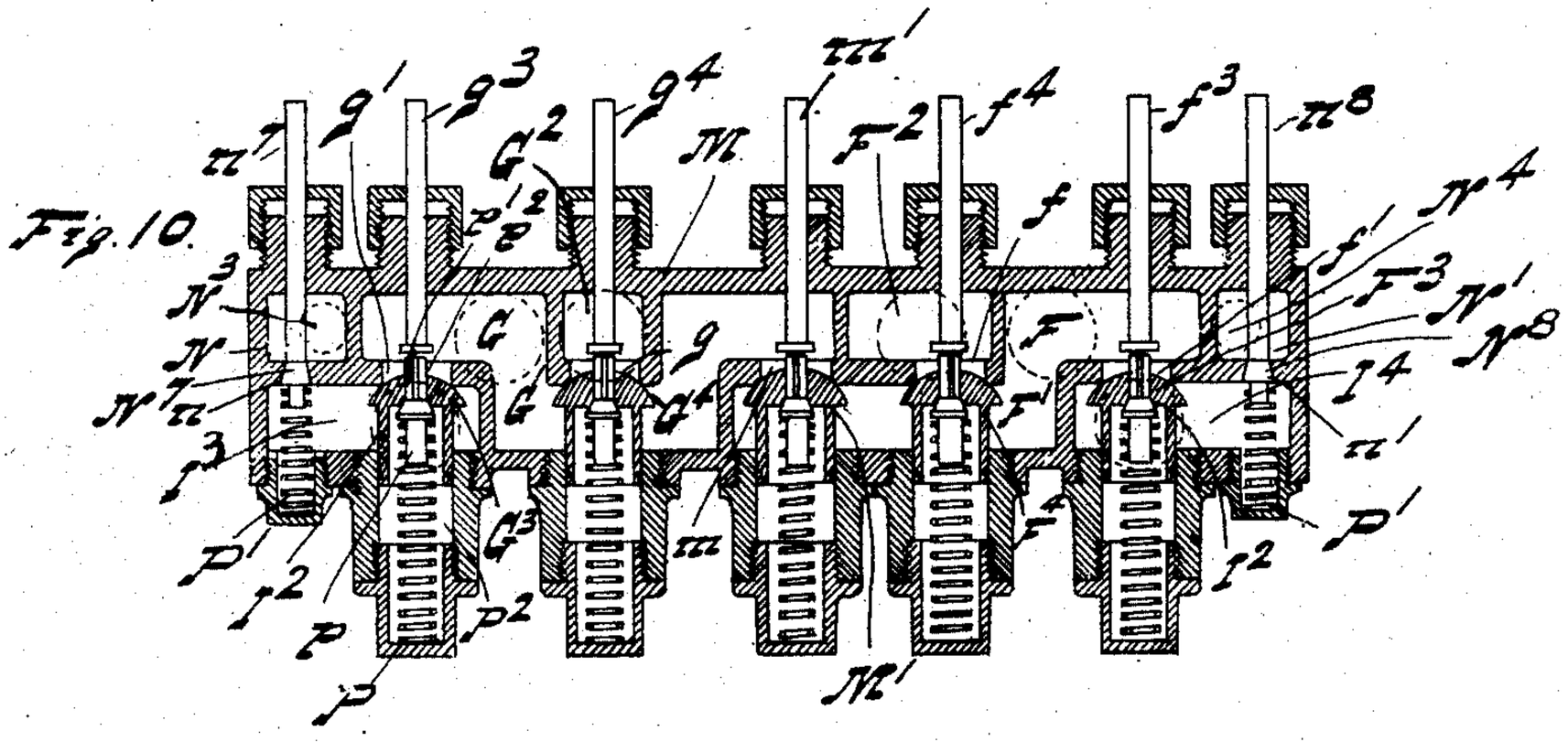


Fig. 11.

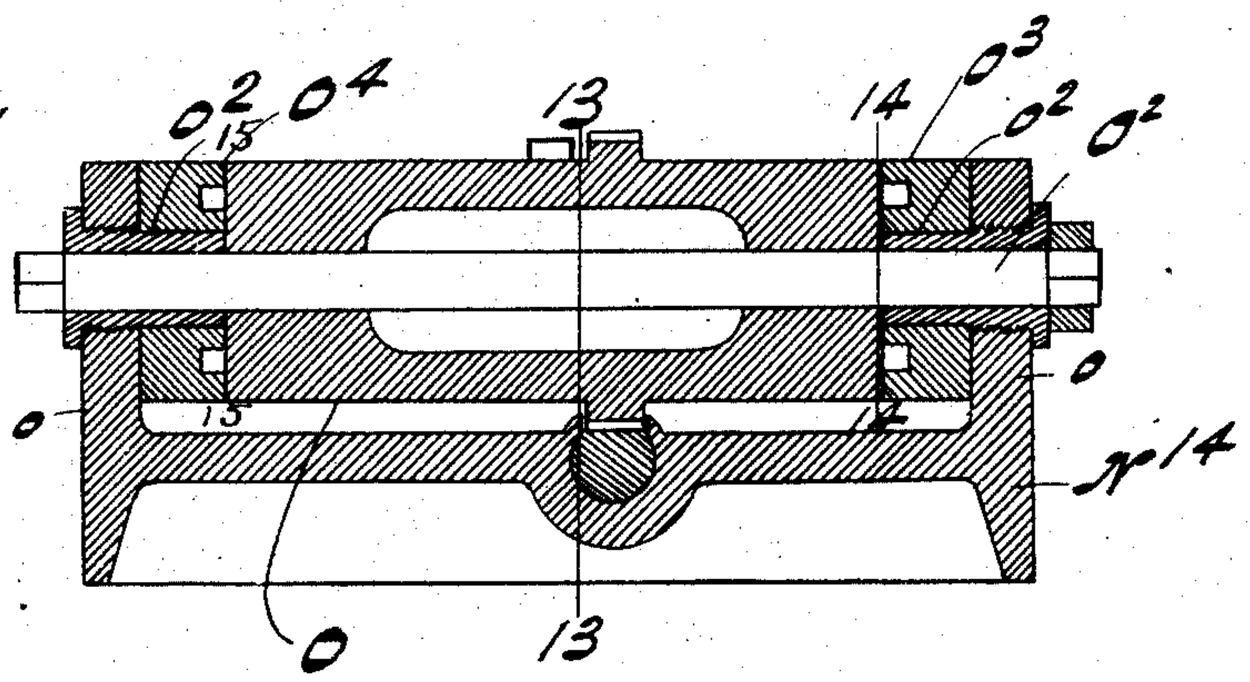


Fig. 12

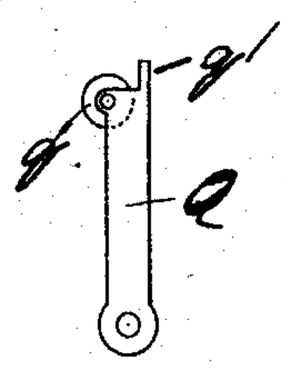


Fig. 13

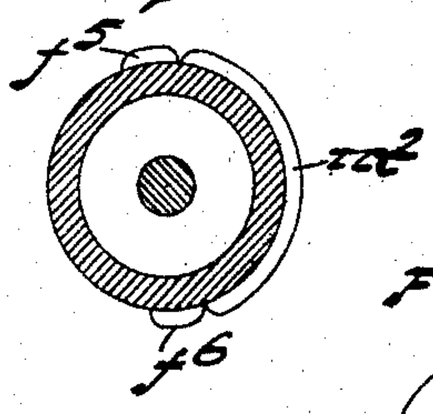


Fig. 14

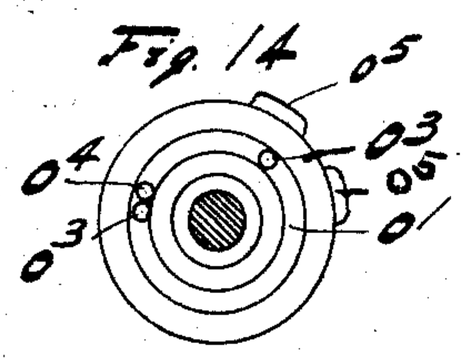
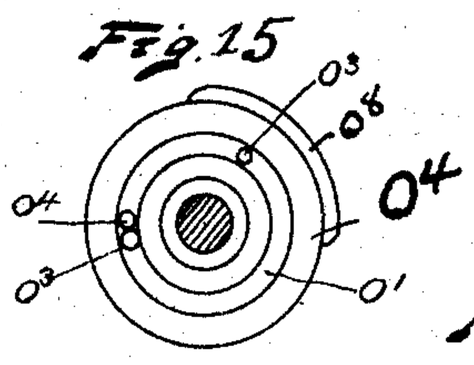


Fig. 15



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4 SHEETS—SHEET 4.

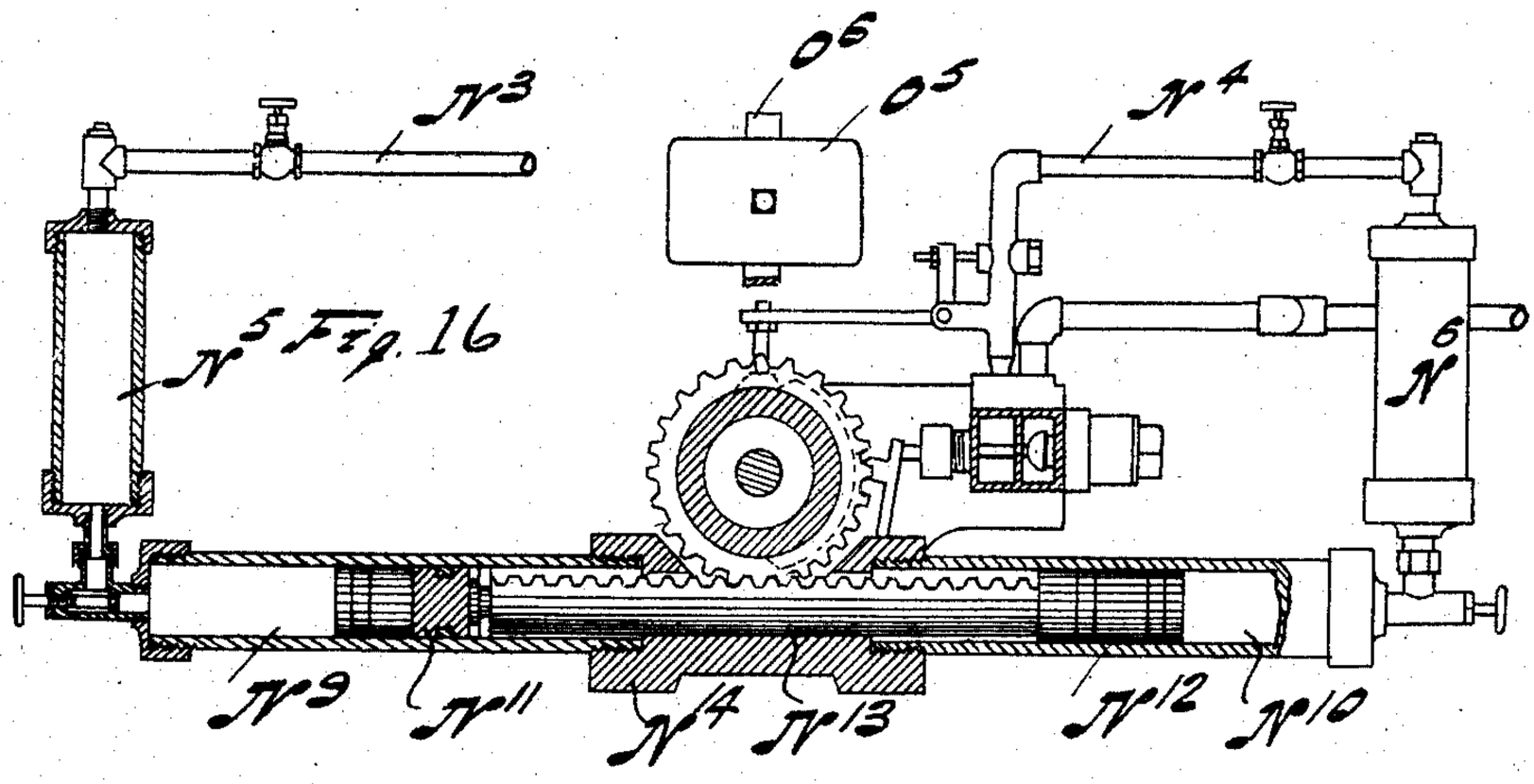


Fig. 16

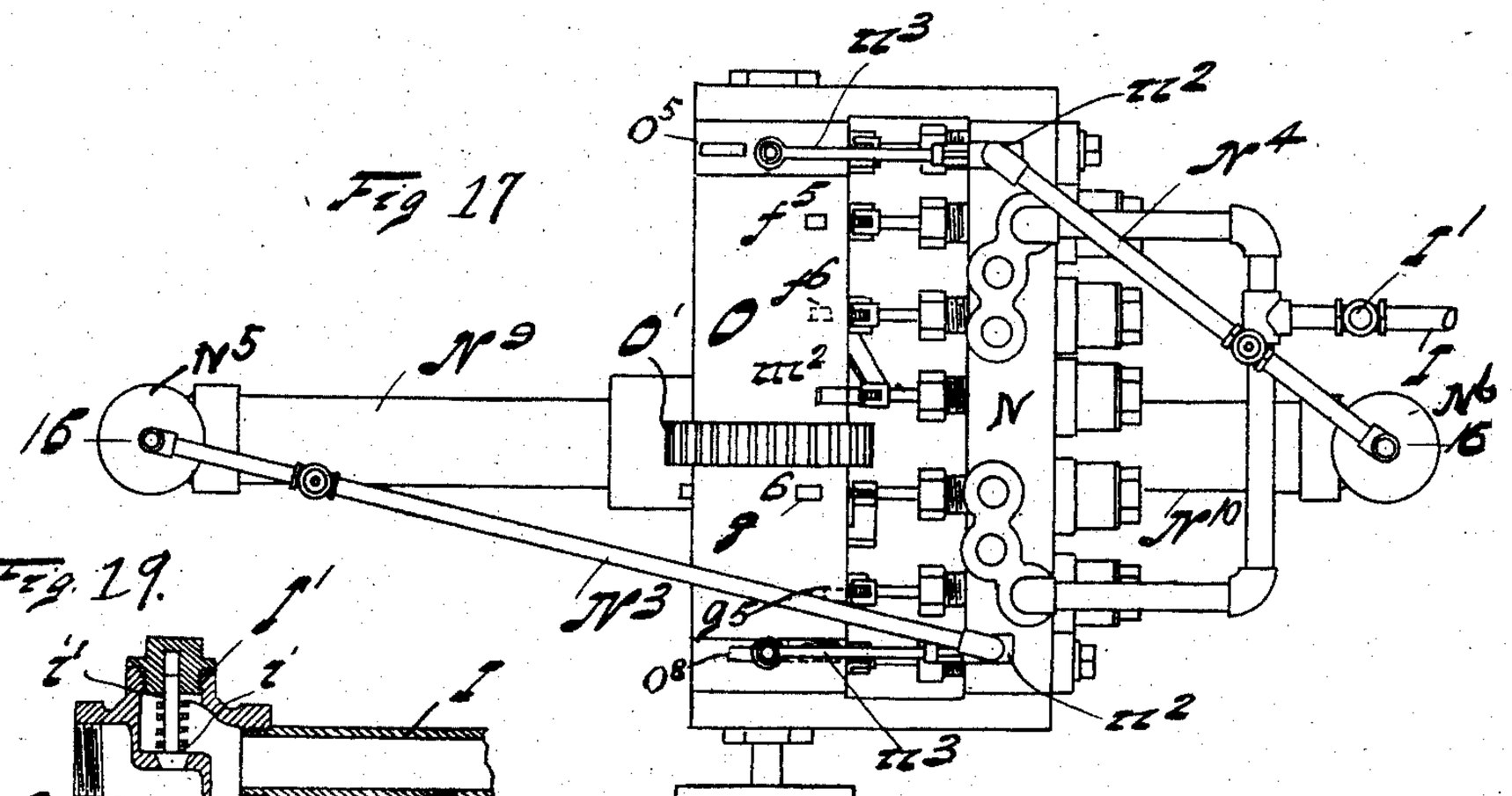


Fig 17

Fig. 19.

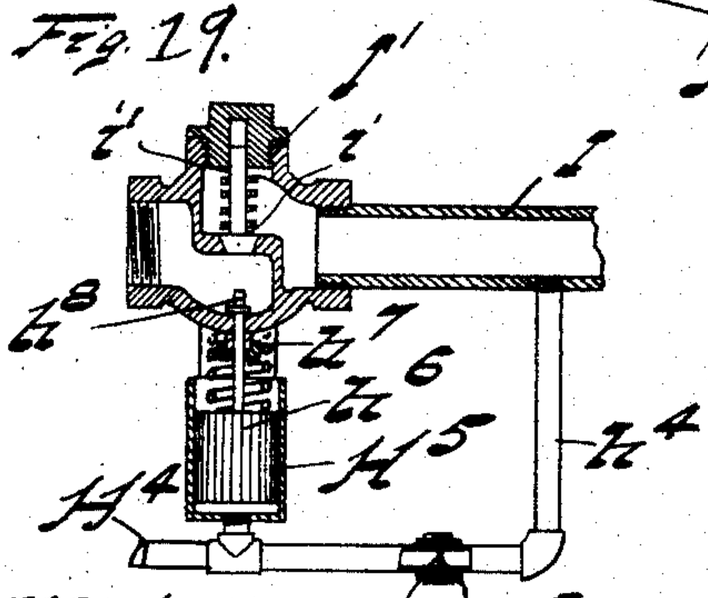
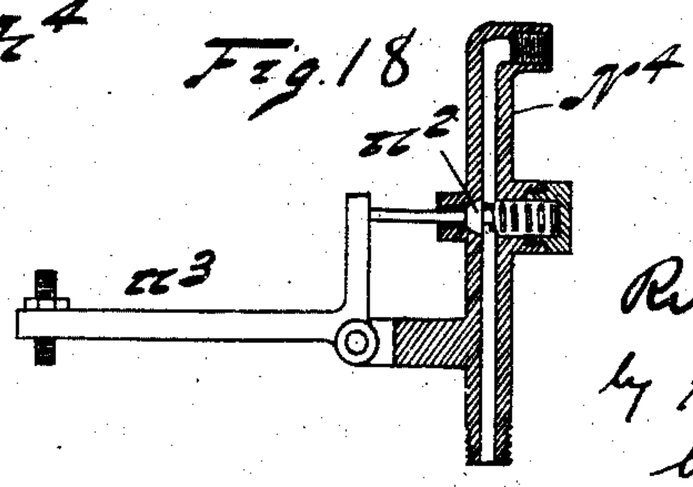


Fig. 18



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UNITED STATES PATENT OFFICE.

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MEANS FOR ACTUATING FLUIDS.

No. 865,296. Specification of Letters Patent. Patented Sept. 3, 1907.

Application filed February 24, 1903, Serial No. 144,712. Renewed January 14, 1907. Serial No. 352,293.

To all whom it may concern:

Be it known that I, RUDOLPH CONRADER, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in Means for Actuating Fluids, of which the following is a specification.

This invention relates to means for actuating fluids, and consists in certain improvements in the construction thereof as will be hereinafter fully described and pointed out in the claims.

The invention as shown is adapted to raising liquids in stages in the general manner of that shown in my Patent #657,917, Sept. 18, 1900.

The general features of the valve scheme herein shown are contained in my application for patent filed June 7, 1901, #63,568. The invention herein contained however is in some of its features distinct in itself and not what would ordinarily be termed simply an improvement in the device contained in the specification above referred to.

The invention is illustrated in the accompanying drawings as follows:—

Figure 1 shows a view of a well with my apparatus in elevation therein. Fig. 2, a section on the line 2—2 in Fig. 3, showing the construction of the return of the eduction tube to well. Fig. 3 is a plan view of the same. Fig. 4 is a section of the lower pump chamber on the line 4—4 in Figs. 6, 7, 8 and 9. Fig. 5 is a section of the same mechanism on the line 5—5 in Figs. 6, 7, 8 and 9. Fig. 6 is a section on the line 6—6 in Fig. 1. Fig. 7, a section on the line 7—7 in Fig. 5. Fig. 8, a section on the line 8—8 in Fig. 4. Fig. 9 shows a section on the line 9—9 in Fig. 4. Fig. 10 shows a central longitudinal section through the valve mechanism. Fig. 11 a central longitudinal section of the operating cam cylinder and parts connected therewith. Fig. 12 is a side elevation of the valve operating rock arm. Fig. 13, a section on the line 13—13 in Fig. 11. Fig. 14, a section on the line 14—14 in Fig. 11. Fig. 15 shows an end view of the cam O^4 shown in section in Fig. 11. Fig. 16, an elevation, a part being broken away in section on the line 16—16 in Fig. 17 of the valve and valve operating motor. Fig. 17 is an elevation of the valve mechanism and operating motor. Fig. 18, a section of the exhaust valve of the valve operating motor. Fig. 19 shows a section of the starting valve mechanism.

The pump in its general operation can be readily understood by reference to my former patent herein before referred to, and is substantially as follows:—The lower pump chamber B is filled through the strainer A by gravity from the well. Above the chamber A is a series of chambers C, D and E. (See Fig. 1) Any convenient number may be used. The chambers B and D are connected with the air pipe F through the connections b^7 and d^7 respectively. The chambers C and E are connected with the valve mechanism by the pipe G through the connection c^7 and e^7. In the operation of the valve air is admitted to the chambers B and D to expel the liquid therefrom. Then communication is made between the chambers B and D and C and E to permit the air to expand from the chambers B and D into said chambers C and E. Then the chambers B and D are cut off to permit them to refill and pressure admitted to the chambers C and E to expel the liquid from them. The use of a series of chambers is common, the purpose being to reduce the lift from each one. In the present construction the liquid passing through the strainer A by gravity passes through the check valve B′ into the chamber B. As it rises in the chamber B it passes through the opening b^2 in the diaphragm b. A float b' is arranged in the chamber B above the diaphragm b, the lower end of the float being so shaped as to form a valve for closing the opening b^2. The upper end of the chamber B is provided with a fitting B^3 which has a lateral passage B^4 leading to one side of the chamber B. This fitting is closed at the top and has the opening b^3 into the chamber B. The upper end of the float b' is valve shaped and arranged to close the opening b^3. As the liquid rises in the chamber B it raises the float, closes the opening b^3 and thus prevents the liquid from entering the air passage. When air is turned onto the chamber B by the valve mechanism hereinafter described liquid is forced from the chamber B through the check valve B^2 through an elbow b^5 connecting with the check valve at the same side of the chamber as the air pipe. This elbow is connected with the eduction tube b^6 which extends upwardly to the lower end of the chamber C and there passes through a fitting c by the check valve c' to the chamber C. The chamber C is provided with a mechanism similar to that shown in chamber B. The liquid is forced from it through the check valve C^2, into the eduction pipe c^6. The floats (not shown) in the chambers C, D and E perform the same functions and in the same manner as in the chamber B.

It is desirable to get as large pump chambers as possible with a given length so that the lift through the pump chamber may be reduced to a minimum. This is particularly true in Artesian wells where the mechanism is confined within the bore of the well. By arranging the pump chambers at one side and placing the air tubes at the other side within the well and also preferably the eduction tubes greater room may be obtained in the pump chambers than by most any other arrangement. This construction also permits of easy access to the pipes and facilitates greatly the assembling of the parts.

I prefer to connect the pump chambers by pipes separate from the air pipes. In this way the air pipes are

relieved of all strain and much leakage avoided. The eduction tube may be carried through this pipe if desired. I prefer, however, that the eduction tube form a separate pipe from one chamber to the other. These connecting pipes when so arranged are approximately the size of the pump chambers and are in line with them. I have arranged the fittings at the ends of the pump chambers into which the air and eduction pipes are screwed. This fitting not only connects the connecting pipes A′ and pump chambers but also forms a connection between the air and eduction tubes and pump chamber. This separate sustaining pipe A″ is an important feature in that where the working pipes are depended on for sustaining the pump chambers there is great danger of losing the apparatus in the well by reason of the caving in of the sides of the well. Where this happens a pump is made to lift the apparatus. Any other arrangement of sustaining mechanism is apt to part. The one herein shown presents a substantially even surface and if there is any twisting or breaking it is of the smaller pipes so that the apparatus in the main can be brought to the surface. In this connection of course it will be understood that the apparatus as a whole is commonly sustained from the top.

It is desirable in oil wells to maintain a certain level in the well. I have provided means which will turn all the air into the main pipe when the oil in the well reaches a certain level and will stop the pump when it is reduced to a certain level. With the mechanism herein shown the pumping apparatus acts continuously after being started until the liquid reaches the lower level. This controlling mechanism is as follows:—Immediately above the pump chamber B is a float chamber H. The float h is arranged in this chamber. The chamber is provided with numerous perforations so that it maintains the level of liquid in the well. Above the float chamber H is a supplemental chamber H′. The chamber H′ is connected through the opening h^3 with a lateral passage H^2 which extends to the air pipe F. A valve h^2 is arranged to control the passage h^3. The valve has the stem h' which is connected with the float h. When the level of liquid in the well reaches a certain height it operates upon the float h and closes the valve h^2. A passage H^3 connects the supplemental chamber H′ with the pipe H^4. This pipe extends to the top of the well and is connected with the main air pipe I by a supplemental pipe h^4. The diaphragm h^5 is interposed between the pipe H^4 and h^4. This diaphragm has a minute opening h^9. The pipe H^4 is connected with a cylinder H^5. The piston h^6 is arranged in the cylinder and its upward movement is opposed by a spring h^7. A stem h^8 extends from the piston into the valve chamber I′. The valve i controls the main air passage I. It is of the check valve variety and is provided with the spring i' for closing it. The operation of this part of the mechanism is as follows:—Assuming that the pump is out of action and the liquid reaches a level in the well at which the pump should be put in action; previous to the liquid reaching this level the leakage of air from the main air pipe I by the pipe h^4, minute opening h^9, pipe H^4 to the chamber H′, passes out of the opening h^3 to an exhaust through the pipe F. As soon as the liquid reaches a level to operate the float h and the valve h^2 is closed. This cuts off the exhaust and the air in the chamber H′ and secondary pipe H^4 and cylinder H^5 increases to the full pressure of the air in the main line. This pressure actuates the piston h^6, which through the stem h^8 opens the valve i and turns on the air to the main or pumping valve. As soon as the desired level of the liquid is reached the valve h^2 is actuated to open the passage h^3 and this effects the reduction of pressure in the cylinder H^5 and a retraction of the stem h^8 thus permitting the valve i to close. It will be understood that this starting mechanism, that is one which is actuated by a level of liquid in the well outside of the pump chamber is applicable to other methods of pumping than the one herein shown.

In some classes of oil there is a great tendency to the formation of paraffin or similar substance which not only interferes with the operation of the pumping apparatus but also the production of the well materially. The apparatus shown is peculiarly fitted for eliminating this difficulty. It may be accomplished by simply using a heated actuating fluid as steam and returning the pumped liquid to the well. The actuating fluid acting upon the liquid in the pump chambers is in contact with the liquid for a considerable period and any condensation as where steam is used is taken care of with the liquid. Therefore pump systems which force the liquid or in other words where the actuating fluid as steam or air is introduced above the liquid or forces the liquid downwardly a greater heating effect is produced. As the liquid is heated and returned to the well in time the inner body of the liquid in the well becomes heated to a sufficient degree to melt the paraffin or similar substances and it is then carried off through the pumping apparatus. The only added mechanism with the apparatus herein shown to effect this purpose is a return connection from the eduction tube to the well. In Figs. 2 and 3 I show such a connection. The eduction tube e^6 passes through a three way cock J. This may be turned so as to run the liquid to the outlet or to a pipe. The pipe K leads from the three way cock and extends to the fitting K′ from which a lateral passage k passes to outside of the fitting and into the tube of the well from which the liquid drops to the bottom of the well or to the level of liquid in the well. The tubing l' has the usual cap L and the apparatus is supported from this cap. The return tube K with the arrangement shown is returned to the well without reducing the strength of this cap.

The valve mechanism for this pumping apparatus is, as before stated, in the main similar to that shown in my pending application. All the valves are arranged in one chamber N. The air from the main pipe enters through the passages I^2, the chambers I^3 and I^4 arranged in the chamber N. The pipes F and G pass from the chambers F′ and G′ in the main body. The chamber I^4 is connected with the chamber F′ by a passage f'. The chamber I^3 is connected with the chamber G′ by a passage g'. The exhaust for the pipe F extends through a passage F^2 and the exhaust for the pipe G through a passage G^2. The exhaust passage F^2 is connected with the chamber F′ by a passage f and the exhaust passage G^2 with the chamber G′ by a passage g. The chambers F′ and G′ are connected by a passage m. The valve F^3 controls the passage f', the valve G^3 the passage g', the valve G^4 the passage g, the valve M′ the passage m. These valves are timed as follows:—The

valve F^3 is open. This turns the air into the pipe F. After the liquid is expelled from the chambers B and D the float valves in those chambers close the outlet so that the pressure in the air lines reaches that of the main air lines. At this pressure the motor hereinafter described is actuated. As soon as the motor starts the valve F^3 is closed and the valve M′ is opened. The air in the pipe F of chambers B and D takes up the clearance in the chambers C and E. As soon as this equalization takes place the valve M′ is closed. The exhaust valve F^4 is opened and the supply valve G^3 is opened. Thus live air is put on the system comprising the chambers C and E, and the air is exhausted from the chambers B and D, so that a fresh supply of liquid enters the chamber B and the liquid from the chambers C and E is expelled, that from the chamber C to the chamber D and that from the chamber E to the surface. As soon as the liquid is expelled from these chambers the same operation takes place only the valves operate in reverse succession. A valve actuating motor is connected with the air supply chamber I^3 and I^4 through passages n and n', chambers N N′, pipes N^3 N^4. The passages n and n' are controlled by the valves N^7 and N^8 respectively. The pipes N^3 and N^4 pass into the reservoirs N^5 and N^6. These are connected through controlling valves with the ends of the cylinders N^9 and N^{10}. The pistons N^{11} and N^{12} are arranged in these cylinders and a rack N^{13} connects the cylinders. A liquid is used in the reservoirs N^5 and N^6 so that the speed of the pistons in the cylinders may be controlled by reducing the inlet passage at the end of the cylinder. The introduction of the liquid also facilitates the packing of the pistons N^{11} and N^{12}. By the cam mechanism hereinafter described at the end of each reverse movement the valve n or n' is opened and as the return movement takes place this valve is allowed to remain open until the weight O^5 passes over the center. This weight is carried by an arm O^6 and the arm O^6 is fixed on a shaft O^2. A cam cylinder O is fixed on this shaft and has a gear O′ which meshes with the rack N^{13}. As soon as the weighted arm passes the center the arm carries the mechanism to the opposite stroke opens the valve n or n' thus starting the reverse movement. This mechanism in its general features is similar to that of my former application referred to and the cam cylinder herein referred to is also similar. It has the cam f^5 for actuating the valve F^3, the cam m^2 for actuating the valve M′, the cam g^6 for actuating the valve G^4 and the cam g^5 for actuating the valve G^3. These cams are so arranged as to open the valves in their proper succession and the cam m^2 is of sufficient length to maintain the valve M′ in its open position to get sufficient length of time to effect an equalization of pressure. At the ends of the cam cylinder O, are the supplemental cam cylinders O^3 and O^4. These are journaled on the lugs o^2 which are secured in the upright o forming a part of the frame N^{14} to which the cylinders N^9 and N^{10} are attached. The shaft O^2 extends through the lugs o^2 so that the movement of the cam cylinder O does not tend to move the supplemental cylinders O^3 and O^4. The supplemental cylinder O^3 is provided with the cam surfaces o^5 and the cylinder O^4 with the cam o^8 and both have the grooves o'. The pins o^3 are arranged in these grooves and pins o^4 are arranged in the ends of the cylinder O. It will be seen therefore that the main cylinder may travel a certain distance without affecting the supplemental cylinders. These pins are so positioned that the main cylinder moves a sufficient part of its oscillation to bring the arm carrying the weight O^5 to the center before the pin o^4 strikes the pin o^3 so as to move the supplemental cylinder and permit the closing of the valve N^7 or N^8 as the case may be. The supplemental cylinder is then carried with the main cylinder and the cam o^5 or o^8 brought beneath an arm n^3. These arms n^3 operate an exhaust valve so that just at the completion of a stroke in either direction an exhaust valve is opened to relieve the pressure on that end of the cylinder which has just been under pressure. This exhaust valve n^2 is arranged in the pipes N^4 and N^3. (See Fig. 18) It is operated by a bell crank lever n^3 which as before stated is actuated by the cams o^5 and o^8. Taking the cams in their order we would say that the cam o^5 holds the valve N^8 in an open position. The air then passing through the pipe N^4 passes to the cylinder N^{10} and starts a movement of the piston N^{12} and a consequent movement of the cylinder O. The cam o^8 at this point is under the exhaust lever n^3 so that the opposite end of the cylinder N^9 has a free exhaust. The first movement of the cylinder O brings the cam f^5 from under the valve F^3 so that it closes. It also brings the cam g^6 from under the valve G^4 so that it closes. It then brings the cam m^2 in position to open the valve M′. This is maintained in an open position throughout the length of the cam m^2. When the arm O^6 passes over its center, pin o^4 at each end has come in contact with the pin o^3 in the groove. At one end it moves the cam o^5 so as to close the valve N^8. At the opposite end it starts the cam o^8 to move from under the exhaust arm n^3 and at the completion of the downward stroke by reason of the weighted arm the cams o^5 and o^8 are carried about a quarter of a revolution thus bringing the one operating the valve N^8 under the exhaust lever n^3 and the opposite one under the valve N^7 so as to open it. Before this occurs however through the continued movement of the cylinder O the valve M′ is closed, and the valves F^4 and G^3 opened. When the parts are reversed simply the reverse action takes place. I prefer that the cams operate through the rock levers Q which are provided with the rolls q, the valves being actuated by the ends q'. The stem n^8 communicates the action of the cam to the valve N^8. The stem f^3 to the valve F^3; the stem f^4 to the valve F^4; stem m' to the valve M′; stem g^4 to the valve G^4; stem g^3 to the valve G^3 and stem n^7 to the valve N^7. The valves N^7 and N^8 are provided with the springs P′ by which they are closed and the other valves in the series are provided with a spring P. Each of these other valves have also a small auxiliary valve p which controls a passage p'. A stem p^2 extends from these valves through the valves in position to be contacted by the stems heretofore described. The springs P operate directly against these auxiliary valves so that when these auxiliary valves are closed the spring operates against the main valve. The purpose of these auxiliary valves is to equalize the pressure on both sides of the main valves and they are opened through the cam action. In this way practically balanced valves may be had with a free working joint and without leakage. As the valves are opened the stem first

opens the auxiliary valves allowing the air under pressure into the chamber P^2 back of the auxiliary valves so that the pressure on both sides of these valves is immediately equalized with a continued movement of the stem it contacts the main valve and opens it.

What I claim as new is:—

1. In an apparatus for actuating liquids, the combination of a pump chamber; means for conveying liquid from said chamber; a connection between said chamber and a source of actuating fluid supply; a by-pass leading from said connection said by-pass leading to the well and having a minute opening; a motor connected with said by-pass at the opposite side of the minute opening from the connection; a passage for permitting the leak from said minute opening to an exhaust; and means actuated by the liquid in the well for closing said passage.

2. In an apparatus for actuating liquids, the combination of a pump chamber; means for conveying liquid from said chamber; a connection between said chamber and a source of actuating fluid supply; a by-pass leading from said connection said by-pass leading to the well and having a minute opening; a motor connected with said by-pass at the opposite side of the minute opening from the connection; a passage for permitting the leak from said minute opening to an exhaust; and means actuated by the liquid in the well outside of the pump chamber for closing said passage to the exhaust.

3. In an apparatus for actuating liquids the combination of a pump chamber; means for conveying liquid from said chamber; a connection between said chamber and a source of actuating fluid supply; means controlled by liquid in the well for opening said connection; and a main valve mechanism for controlling the pumping action after the connection is open.

4. In an apparatus for actuating liquids the combination of a pump chamber; means for carrying liquid from said chamber; a connection between said chamber and a source of actuating fluid supply; means controlled by liquid in the well for opening and closing said connection; and a main valve mechanism for controlling the pumping action after the connection is open.

5. In an apparatus for actuating liquids the combination of a pump chamber; means for conveying liquid from said chamber; a connection between said chamber and a source of actuating fluid supply; means controlled by liquid in the well for opening said connection; and a main valve mechanism controlling said main valve action being arranged to alternately open said connection to the air supply and to an exhaust.

6. In an apparatus for actuating liquids the combination of a pump chamber; means for conveying liquid from said chamber; a connection between said chamber and a source of actuating fluid supply; means controlled by liquid in the well for opening said connection; a main valve mechanism for controlling the pumping action after the connection is open, said valve being arranged at a distance remote from the pump chamber as at the top of the well.

7. In an apparatus for actuating liquids the combination of the pump chamber; means for conveying liquid from said chamber; a connection between said chamber and a source of actuating fluid supply; a valve controlling said connection; a motor controlling said valve, said motor being at a distance from the pump chamber as the top of the well; means actuated by the liquid in the well for controlling said motor and a main or pumping action for controlling the pumping valve after the connection is open.

8. In an apparatus for actuating liquids the combination of a pumping chamber arranged to actuate liquid by bringing an actuating fluid in direct contact therewith; a valve mechanism adapted to control a heated fluid so as to effect a pumping action; means for conveying liquid from said pump chamber and a return connection to the well.

9. In an apparatus for actuating liquids by the direct contact of the actuating fluid with the liquid, the combination of a pump chamber; means for conveying liquid from said chamber by introducing the actuating fluid above the liquid and forcing the liquid from said chamber; a valve mechanism used to control a heated actuating fluid for effecting a pumping action and a return connection to the well from the means for conveying liquid from said chamber.

10. In an apparatus for actuating liquid by direct contact of the actuating fluid with the liquid, the combination of a series of pump chambers; a valve mechanism adapted to control a heated actuating fluid and introduce it to alternate chambers in said series alternately; means for conveying liquid from one to the other of said chambers and for conveying liquid from the last of the series of chambers to the well.

11. In an apparatus for actuating liquids in Artesian wells the combination of a series of cylindrically shaped pump chambers; headers for said chambers having ducts leading to one side of said chambers; and pipes for conveying actuating fluid to said chambers connected with said chambers through said headers, said pipes being arranged entirely at one side of said chambers.

12. In an apparatus for actuating liquids in Artesian wells the combination of a series of pump chambers connecting pipes supporting said chambers separate from the pipes conveying actuating fluid; and pipes for conveying actuated fluid from said chambers arranged entirely at one side of said pumping chambers.

13. In an apparatus for actuating liquids in Artesian wells the combination of a series of chambers; supporting pipes connecting said chambers, said pipes being separate from the pipes conveying actuating fluid to said chambers and actuated fluid from said chambers, said pipes conveying actuating and actuated fluid being arranged entirely at one side of said chambers and connecting pipes.

14. In an apparatus for actuating liquids in Artesian wells the combination of a series of pump chambers; connecting and supporting pipes being in a line with said chambers of approximately the diameter of said chambers, said supporting pipes being separate from the air pipes conveying actuated fluid from said chamber and said pipes for conveying actuating fluid.

15. In an apparatus for actuating liquids in Artesian wells the combination of a series of pump chambers; connecting and supporting pipes being in a line with said chambers of approximately the diameter of said chambers, said supporting pipes being separate from the air pipes conveying actuating fluid arranged entirely at one side of said chambers and connecting pipes.

16. In an apparatus for actuating liquids in Artesian wells the combination of a series of pump chambers having headers with ducts leading to the side of the chambers and connecting or supporting pipes secured to said headers and arranged in line with the pump chambers; and pipes for conveying actuating fluid to said chambers through said headers.

17. In an apparatus for actuating fluids in Artesian wells the combination with the pump chambers B and C; the headers thereon having ducts leading to the sides of the chamber; the eduction tubes b^6 and c^6 and the air pipes F and G connected with said chambers through said headers.

18. In an apparatus for actuating liquids, the combination with the pump chamber B having the header B^3 thereon with the passage B^4 and b^3 therein, the header at the bottom of said chamber having the elbow b^5 extending therefrom and check valve B^2 therein; and a float b' arranged in said chamber adapted to operate upon the passages b^2 and b^3.

19. In an apparatus for actuating liquids the combination with the chamber B of a header B^3 having a lateral passage B^4, passage b^3 and an upwardly extending fitting for connecting the support for the chamber and an air pipe connected with the passage B^4.

20. In an apparatus for actuating fluids the combination of a pump chamber; a connection for carrying actuating fluid to said chamber; a valve mechanism controlling said connection; a motor controlling said valve mechanism, said valve mechanism controlling a valve for a pas-

sage leading to the motor; an exhaust valve for said motor; and means for opening said exhaust valve after the closing of the supply to said motor.

21. In an apparatus for actuating fluids the combination of a pump chamber; a connection for carrying actuating fluid to said chamber; a valve mechanism controlling said connection; a motor controlling said valve mechanism, said valve mechanism controlling a valve for a passage leading to the motor; an exhaust valve for said motor; means for opening said exhaust valve after the closing of the supply to said motor; a cam operated by said motor; and means operated by the cam for operating said exhaust valve.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

RUDOLPH CONRADER.

Witnesses:
M. C. SULLIVAN,
H. LIPPOLD.